Overview of the Spacecraft Design for the Psyche Mission Concept

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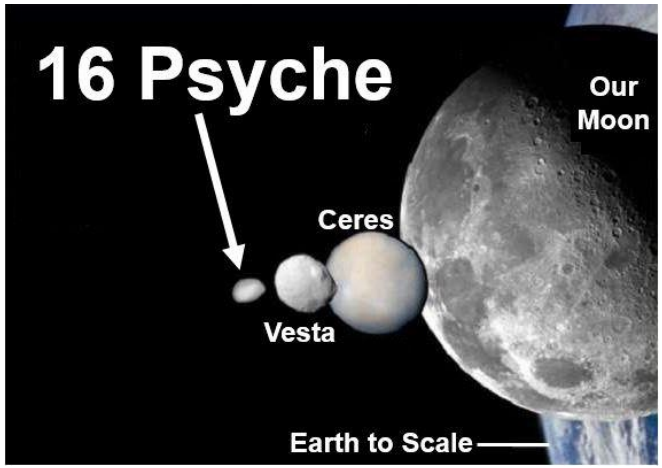
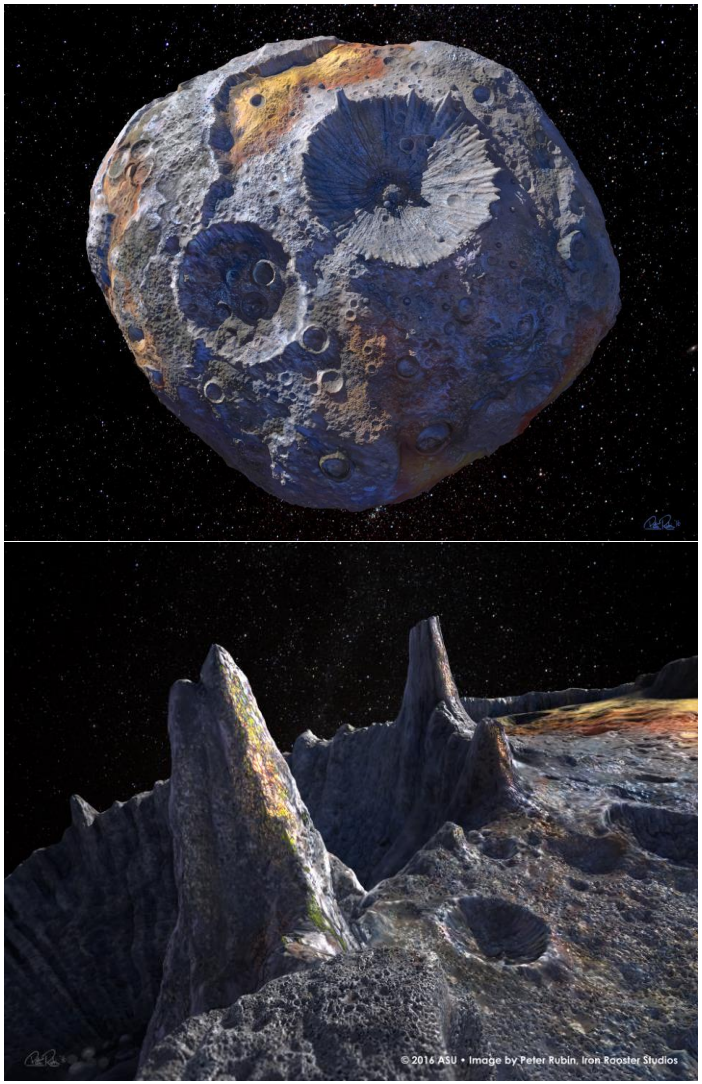
(16) Psyche characteristics

- Discovered in 1852 (Naples)
- 10th largest asteroid
- a = 2.92 AU, e = 0.140, i = 3.09 deg
  - Relatively easy access with solar electric propulsion (SEP)
- Rotation period: 4.196 hours

- Irregular shape
  - Shape model from radar and lightcurve analysis
  - Volumetric mean radius = 113 km (Shepard et al., 2017)
  - Best fit ellipsoid: {134, 114, 95} km radii



Why (16) Psyche?



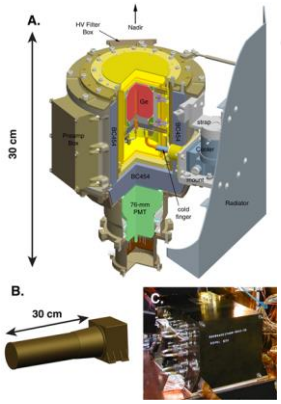
- Largest M-type asteroid
- High density
- High radar albedo
- High thermal inertia (120 tiu)
- Spectra: 10% silicate, 90% metal

- "Not just unique, but an improbable body"

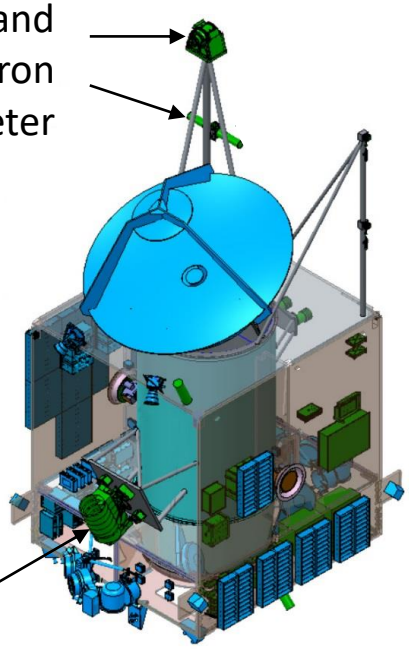
- Strong testable hypothesis
  - *"Is (16) Psyche the exposed core of larger differentiated body?"*
  - *"Was (16) Psyche created by a slow accretion of metal-rich material?"*

Whatever hypothesis is determined, results would be scientifically significant

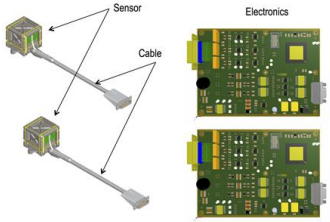
Psyche Spacecraft: Instrument Overview

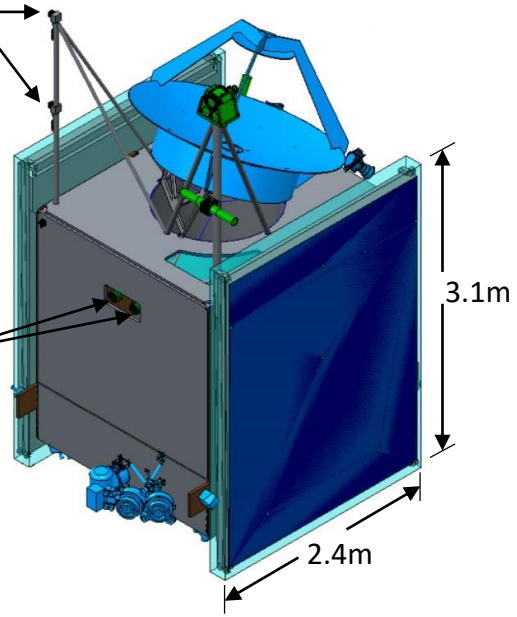


Gamma Ray and Neutron Spectrometer

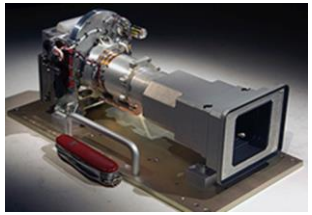


Magnetometer Sensors

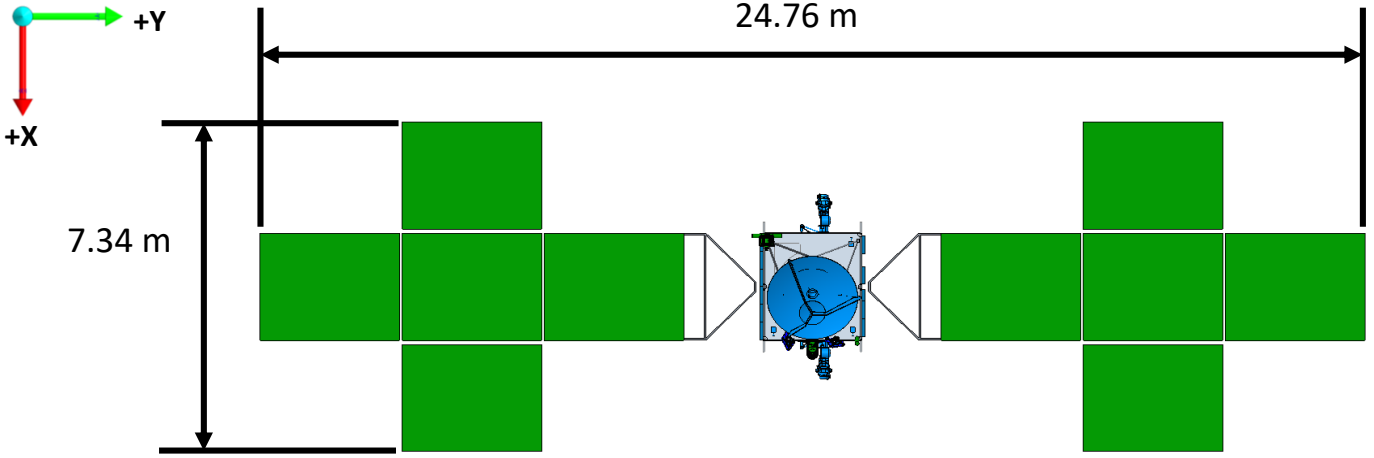




Imagers



Deep Space Optical Communications



Psyche Spacecraft: Leveraging key strengths

Similarities to GEO…

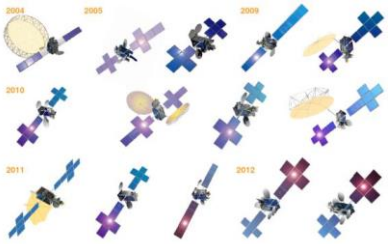
Launch

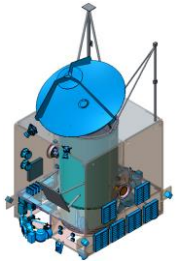
High Power

Electric Propulsion

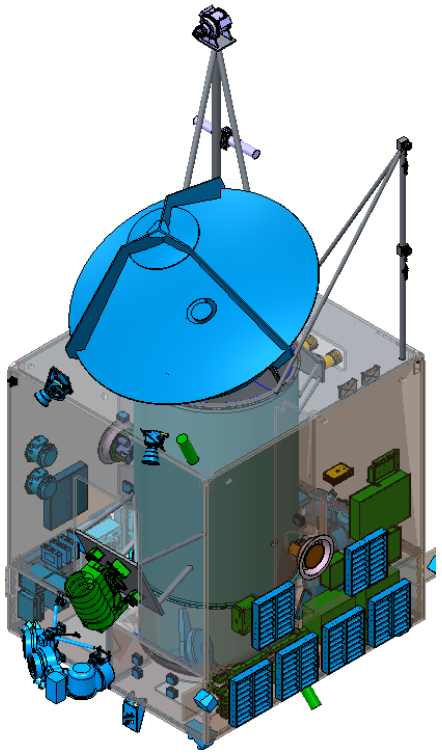
High Reliability, Long Lifetime

- Composite Structure
- High Power
- Electric Propulsion



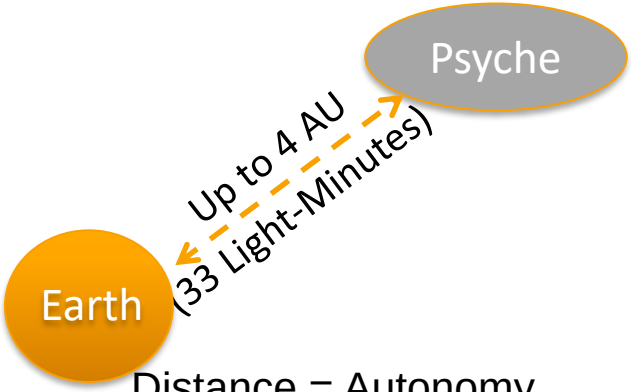


SEP Chassis



Psyche

Differences from GEO…

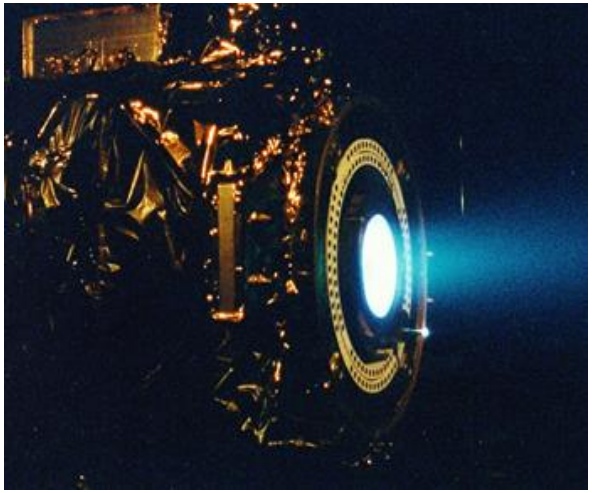


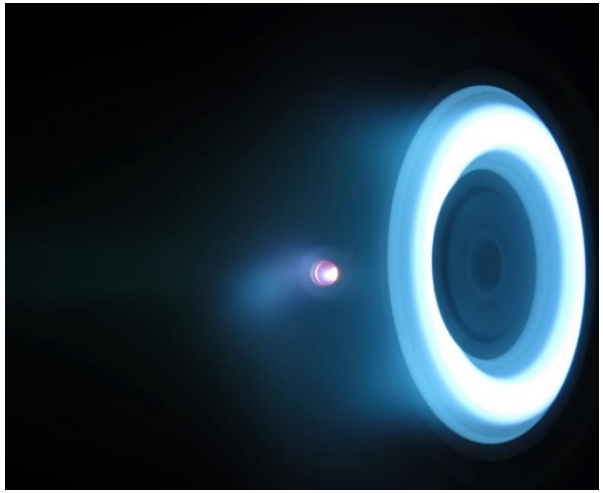
Distance = Autonomy

- Autonomous Ops & Fault Protection

JPL Flight Software and C&DH

Solar Electric Propulsion: Advances in 20 years

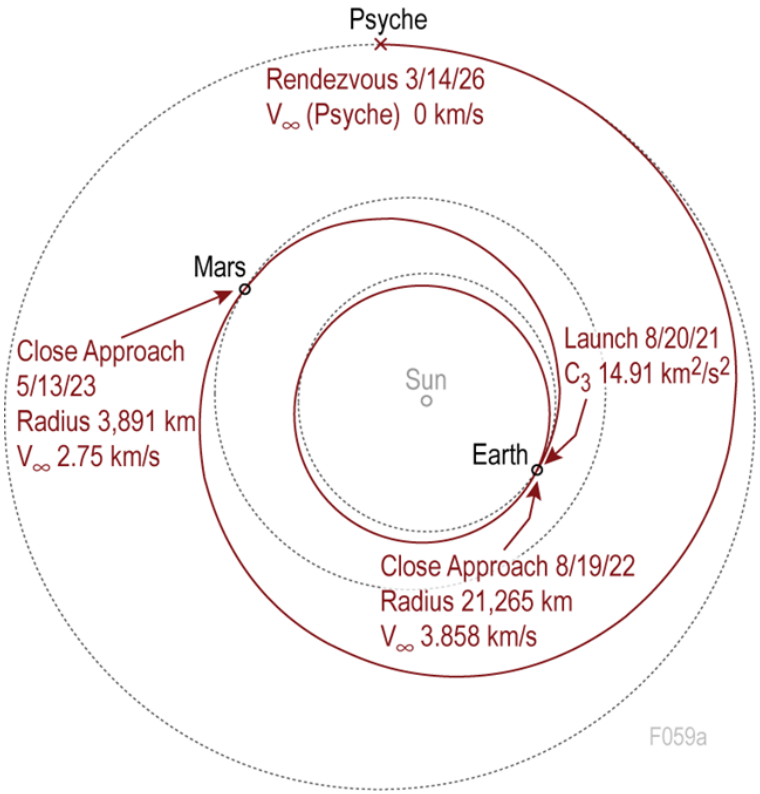




	NSTAR	SPT-140
Spacecraft	Deep Space 1, Dawn	Psyche, SSL GEO S/C
Type	Ion thruster	Hall effect thruster
First flight	1998	2018 (planned)
Operating power range	0.5 – 2.3 kW	0.9 – 4.5 kW
Max thrust	91 mN	262 mN
Max specific impulse	3100 sec	1720 sec
Throughput (Xenon)	~250 kg	500 kg

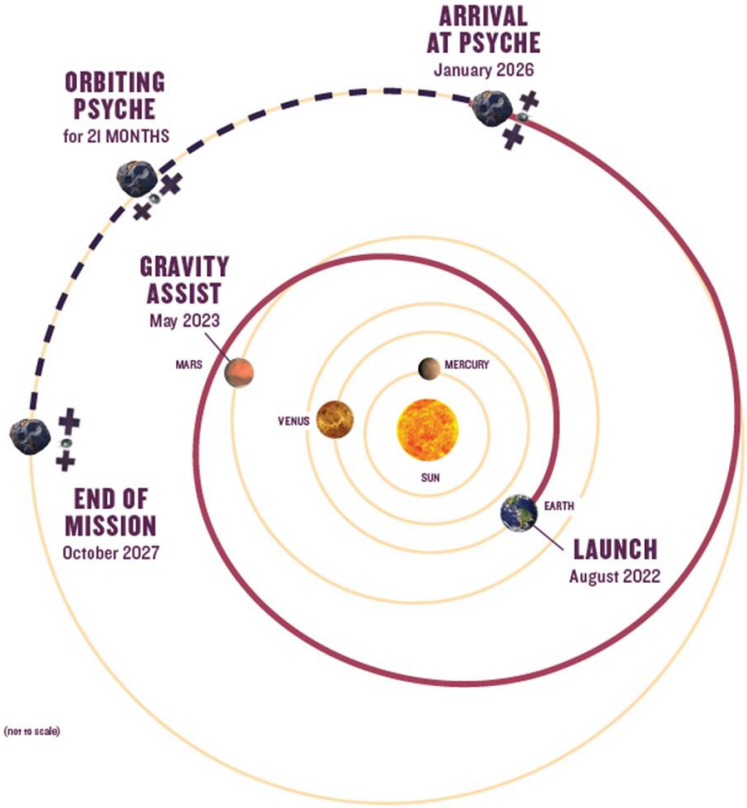
What's changed: Baseline Mission Design (proposal)

- Dawn-like mission design
- Launch from KSC
- Earth, Mars Flybys
- Min Solar Range: 0.89 AU
- Max Solar Range: 3.3 AU
- Cruise: 4.6 Years (54 months)
- Orbital Operations: 21 months



What's changed: Baseline Mission Design (present)

- Dawn-like mission design
- Launch from KSC
- Mars Flyby (no Earth flyby)
- Min Solar Range: 1.0 AU
- Max Solar Range: 3.3 AU
- Cruise: 3.5 Years (42 months)
- Orbital Operations: 21 months

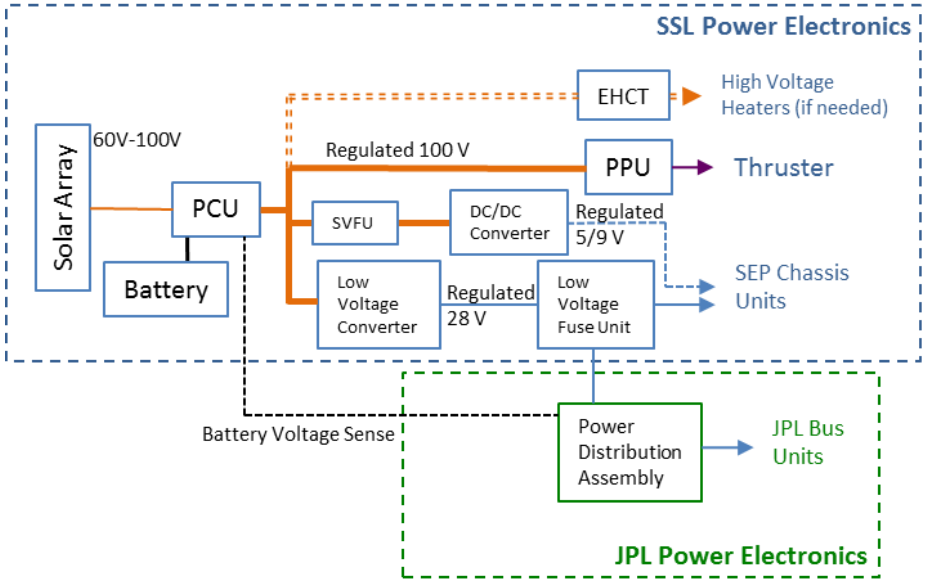


What's changed: External configuration

Post-Selection (Jan 2017)	Baseline (Feb 2018)
Solar array power @ 1 AU: 15.9 kW	Solar array power @ 1 AU: 19.9 kW
Solar array power @ 3.3 AU: 2.0 kW	Solar array power @ 3.3 AU: 2.5 kW
Delivered mass: 1,946 kg	Delivered mass: 1,965 kg

What's changed: Power subsystem design

- Proposal design emphasis on heritage
  - Limited eclipse durations permitted
  - Unable to fire electric propulsion during eclipse
- Power subsystem trade re-opened post-selection
  - Resulted in battery change
  - 144 A-hr, part of SSL product line

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